

AcuSolve™ Coupling with Abaqus FEA

Direct-Coupled Multiphysics Solution for Best Fluid-Structure Interaction Simulation Results

A Powerful CFD Solver for Design and Analysis

AcuSolve from ACUSIM Software, Inc. enables scientists and engineers to seamlessly integrate a powerful computational fluid dynamics (CFD) solver with their design and analysis applications. AcuSolve is a general-purpose, finite element based CFD solver and is unique in the CFD solutions market, offering superior robustness, speed, and accuracy. Users can quickly obtain quality solutions without iterating on solution procedures or worrying about mesh topologies or element types.

Solving Complex FSI Problems

The integration of AcuSolve's FSI capabilities and SIMULIA's Abaqus Finite Element Analysis (FEA) software delivers a best-in-class solution for solving complex multidisciplinary design problems involving coupled fluid flow and structural phenomena.

AcuSolve provides two powerful capabilities for simulating Fluid-Structure Interaction (FSI) and response to fluid forces:

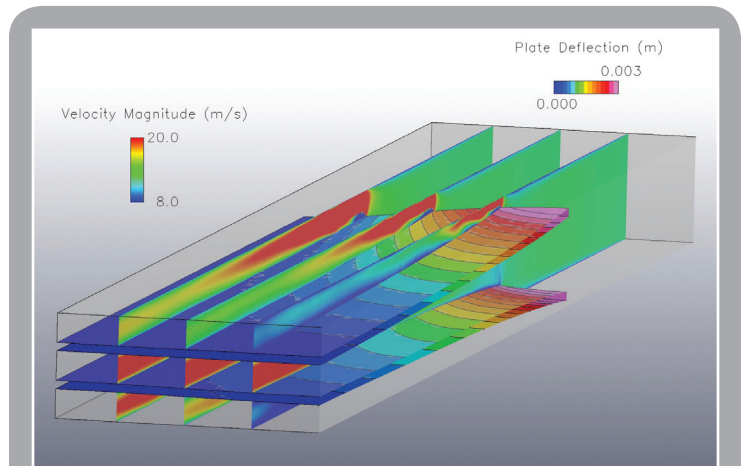
- **Practical FSI (P-FSI)** predicts linear solid/structural responses.
- **Direct-Coupled FSI (DC-FSI)** predicts large deformation and non-linear solid/structural responses.

AcuSolve P-FSI with Abaqus FEA

AcuSolve P-FSI picks up the structure response, frequency, and mode shapes from an Abaqus Simulation and solves for the deformation and mesh motion under fluid forces, all within AcuSolve.

AcuSolve DC-FSI with Abaqus FEA

AcuSolve DC-FSI and Abaqus are coupled directly and without any intervening third party software to perform large deformation FSI and/or thermal analyses. This coupled methodology is superior for transient applications that exhibit nonlinear structural response due to large deformations, material nonlinearities, or complex contact. The two applications can run concurrently on the same or different computers with single or multiple processors.



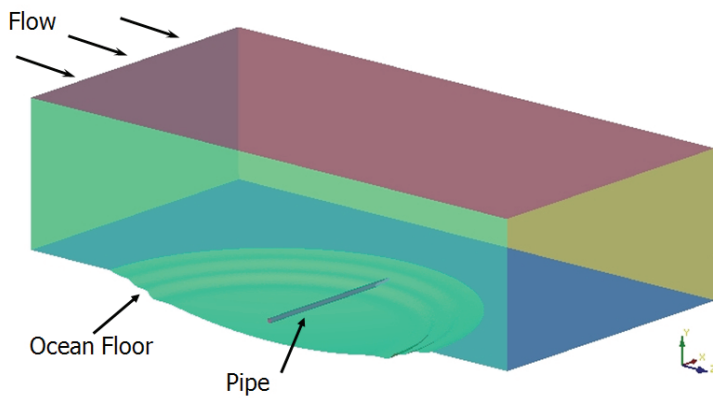
Flow Induced Vibration of Nuclear Reactor Fuel Plates:
Prediction of the critical flow velocity that leads to plate buckling

"ACUSIM's approach to direct-coupling provides a very powerful capability for the FSI solution space. The coupling of AcuSolve and Abaqus combines specific, class-leading capabilities from each application and presents a strong offering to solve the most challenging FSI problems."

Ken Short
Vice President of Strategy and Marketing
SIMULIA

Features and Benefits

- Pre- and Post-Processing in Abaqus/CAE and SIMULIA SLM
- Next Generation CFD Solver Based on Superior Finite Element Technology
- Advanced Computer Aided Design (CAD)-Driven Meshing Technology Using Unstructured Mesh with Boundary Layers
- Direct Coupled FSI Methodology
- Rich Physics and Solution Options
- Highly Robust, Fast and Accurate
- Fully Parallel and Scalable from Desktops to Large Clusters
- Available on Unix, Linux, Windows XP/Vista/Windows 7, and Windows HPC Server 2008

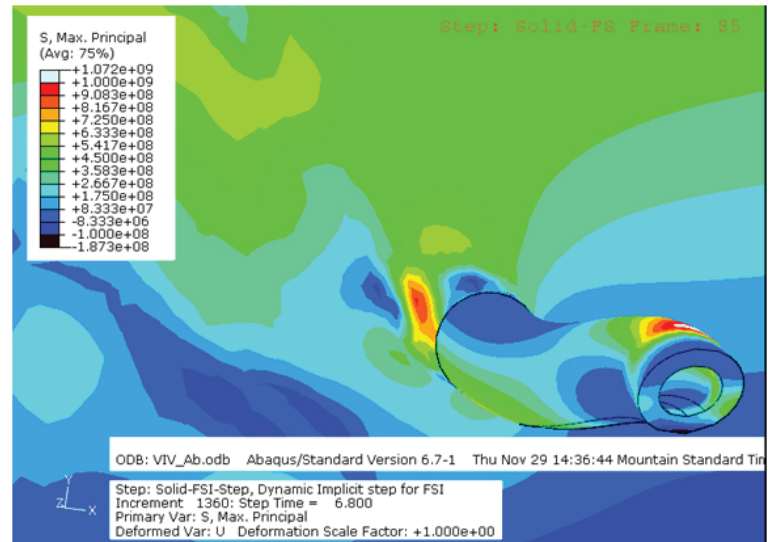


- $OD = 0.5\text{ m}$; $ID = 0.3\text{ m}$; $Length \sim 16.6\text{ m}$
- $Density = 7850\text{ kg/m}^3$; $E = 2.07e11\text{ Pa}$; $Poisson's\ ratio = 0.3$

Case Study: Subsea Pipeline Simulation

Transport of oil and gas from ocean floor wells to land-based production facilities requires the use of subsea pipelines that can vary in length from tens of kilometers to over 1,000 kilometers. Along the undersea route, the pipeline can traverse a complex landscape of jagged peaks and valleys. Strong subsea cross-currents can cause a pipeline to go into a self-excited oscillation and potentially cause fatigue or slam the pipeline against the seabed floor. The resulting damage can be very expensive to repair and may result in environmental contamination.

The potential for self-excitation is caused by a fluid flow phenomenon called Vortex-Induced Vibration (VIV). Richard Gosling, of Andrew Palmer and Associates, regularly faces the challenges of solving this type of FSI problem. "In exposed pipeline spans, VIV can cause significant fatigue problems," states Gosling. "The direct coupling of AcuSolve and Abaqus enables our engineers to use a 3D environment to analyze fluid-structure interaction and predict the effect of vortex-induced vibration on the structural integrity and fatigue life of pipelines. This capability has transformed our ability to assess the effectiveness of mitigation measures, such as the use of helical strakes, to avoid fatigue problems in exposed subsea pipeline spans."



Co-simulation results of a FSI analysis performed by coupling AcuSolve with Abaqus. A flowfield and deformed pipeline is shown at an elapsed simulation time of 6.8 seconds. The ocean current flow is from right to left and the stress on the pipe is visualized along with the flow velocity magnitude.

About ACUSIM Software, Inc.

ACUSIM Software provides engineers and scientists with superior Computational Fluid Dynamics (CFD) solutions. ACUSIM's products are used globally in a wide variety of industries such as automotive, electronics, chemical, bio-medical, consumer products and energy, as well as national labs and universities.

Headquartered in Mountain View, California, ACUSIM Software markets its flagship product, AcuSolve™, and its associated pre-processor, AcuConsole™, post-processor, AcuFieldView™, and desktop solution, AcuDesktop™, through direct sales and distributor channels.

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